DESCRIPTION

NICOTINE-REDUCING AGENT AND NICOTINE-REDUCING METHOD

TECHNICAL FIELD

The present invention relates to a nicotine-reducing agent and a nicotine-reducing smoking article that are used for reducing the nicotine content of the mainstream smoke of a tobacco product. The present invention also relates to a method for reducing the nicotine content and reducing the tar content of the mainstream smoke of a tobacco product by using the nicotine-reducing agent or nicotine-reducing smoking article.

BACKGROUND ART

Tobacco smoke is considered to contain about 4,000 kinds of chemicals, among which harmful and carcinogenic substances are known to be included. Of the harmful substances contained in tobacco smoke, typical examples are nicotine, tar and carbon monoxide. Various approaches have been made to remove such harmful substances from tobacco smoke.

As an example of such approaches, a method has been proposed for reducing the nicotine content in inhaled tobacco smoke (i.e., mainstream smoke) by infiltrating the filter of a tobacco pipe with water, so as to contact tobacco smoke with water (see Patent Documents 1 to 3). This method is based upon the water solubility of nicotine contained in tobacco smoke. However, while a nicotine-reducing effect can be expected from this method, there is a possibility that water containing harmful nicotine and tar may enter the mouth together with smoke during smoking, and pass into the body.

Methods for preventing or eliminating this problem have been proposed: for example, a method in which a cyclodextrin and a water-absorbing polymer are contained in the mouthpiece filter of a cigarette (Patent Document 4); and

a method which employs a porous polymer as a component of the filter of a smoking pipe that is attached to the mouthpiece portion of a cigarette when used (Patent Documents 5 and 6). In the former method, however, the mouthpiece filter absorbs large amounts of water at high humidities, causing the inhaling resistance to increase during smoking, thus making smoking itself difficult.

Moreover, wooden and plastic quit-smoking pipes are also known which incorporate a filter containing a viscous liquid (Patent Document 7). This method, however, is troublesome in that an accessory has to be attached to the pipe when smoking. In addition, an agent for removing nicotine and tar is also known (Patent Document 8), in which case a thin coating of a gelled substance is applied to the filter or mouthpiece surface of a cigarette, and the cigarette is smoked either directly or by being inserted into a pipe. However, such a gelled substance does not penetrate into the cigarette filter, so that the gelled substance remaining on the filter spreads into the mouth to give an unpleasant sensation, also making it difficult to inhale.

One consideration that has to be made in an approach to removing harmful substances, particularly nicotine, from tobacco smoke is that smokers are nicotine-dependent. Smokers, in general, are mentally or physically dependent on nicotine, and therefore it is not necessarily preferable for smokers to suddenly reduce their nicotine intake. It is thus desirable that nicotine intake be reduced depending on the physical and mental condition of the smoker. This would allow gradual reduction or alleviation of the smoker's mental and physical dependency on nicotine, ultimately enabling them to quit smoking. Hence, rather than just reducing the amount of nicotine equally for all smokers, there is a need for a method that allows smokers to control the nicotine intake themselves according to their condition.

[Patent Document 1] Japanese Unexamined Patent Publication No.

1973-53871;

[Patent Document 2] Japanese Unexamined Patent Publication No. 1975-130579;

[Patent Document 3] Japanese Unexamined Patent Publication No. 1987-198378;

[Patent Document 4] Japanese Unexamined Patent Publication No. 1976-32799;

[Patent Document 5] Japanese Unexamined Patent Publication No. 1987-179376;

[Patent Document 6] Japanese Unexamined Patent Publication No. 1972-30900;

[Patent Document 7] Japanese Unexamined Patent Publication No. 1981-18583; and

[Patent Document 8] Japanese Unexamined Patent Publication No. 1986-177972.

DISCLOSURE OF THE INVENTION

Problem to be Solved by the Invention

An object of the present invention is to provide a nicotine-reducing agent and a nicotine-reducing smoking article that are used for reducing the nicotine content of the mainstream smoke of a tobacco product. Another object of the present invention is to provide a method for reducing the nicotine content and reducing the tar content of the mainstream smoke of a tobacco product by using the nicotine-reducing agent or nicotine-reducing smoking article.

Means for Solving the Problem

The present inventors conducted extensive research in order to develop a method for reducing the nicotine content of the mainstream smoke of a tobacco product. As a result, it was found that an aqueous liquid composition with a viscosity adjusted to 500 to 3000 mPa·s and containing a specific polysaccharide, such as tamarind seed gum, xanthan

gum, locust bean gum, etc., is excellent at adsorbing and removing nicotine from the mainstream smoke of a tobacco product; and that smoking is hardly affected by impregnating the filter of a tobacco product or smoking article with the aqueous liquid composition. Moreover, the inventors confirmed that using such a polysaccharide, in combination with saccharide(s) where necessary, it is possible to obtain an aqueous liquid composition which is unlikely to be affected by temperature variations, long-term preservation, etc., and has stable viscosity and quality throughout the seasons; and that the aqueous liquid composition can make a suitable nicotine-reducing agent for implementing the aforementioned method of reducing nicotine.

In addition, the inventors confirmed that a larger amount of nicotine can be removed from the mainstream smoke of a tobacco product by increasing the amount of the aqueous liquid composition used (amount applied to the filter). This means that smokers can easily control themselves the amount of nicotine inhaled into the body during smoking by adjusting the amount of the aqueous liquid composition used. That is, using the aqueous liquid composition, the amount of nicotine inhaled into the body can be gradually reduced by gradually increasing the amount of the aqueous liquid composition used (amount applied to the filter) in accordance with the level of nicotine dependence of the smoker. This alleviates nicotine dependence, which is the primary problem in smoking cessation, allowing the smoker to ultimately quit smoking.

The present invention was accomplished based on these findings. The present invention provides the following embodiments.

Item 1. A nicotine-reducing agent which is an aqueous liquid composition having a viscosity of 500 to 3000 mPa·s and containing at least one polysaccharide selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan,

psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carageenan.

Item 2. A nicotine-reducing agent according to Item 1, wherein said at least one polysaccharide is selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum and pectin.

Item 3. A nicotine-reducing agent according to Item 1, wherein said at least one polysaccharide is selected from the group consisting of tamarind seed gum, locust bean gum and xanthan gum.

Item 4. A nicotine-reducing agent according to Item 1, further comprising at least one saccharide.

Item 5. A nicotine-reducing agent according to Item 4, wherein said at least one saccharide is selected from the group consisting of trehalose, starch syrup, sucrose, glucose, fructose, maltose, sorbitol, maltitol, lactitol, erythritol, xylitol and dextrin.

Item 6. A nicotine-reducing agent according to Item 4, wherein said at least one saccharide is selected from the group consisting of trehalose and starch syrup.

Item 7. A nicotine-reducing agent according to Item 1, which is used by being retained in a filter of a smoking article.

Item 8. A packaged nicotine-reducing agent comprising a nicotine-reducing agent according to Item 1 filled in a container.

A liquid-dropping container can be advantageously used as the container.

Item 9. A nicotine-reducing smoking article comprising a filter retaining a nicotine-reducing agent according to Item 1.

Item 10. A nicotine-reducing smoking article according to Item 9, comprising a holder body having an

inhalation opening at one end and a tobacco product insertion opening at the other end, and a filter provided in the holder body and retaining a nicotine-reducing agent according to Item 1.

Item 11. A nicotine-reducing smoking article in the form of a tobacco product holder comprising a holder body having an inhalation opening at one end and a tobacco product insertion opening at the other end, and a filter provided in the holder body, the tobacco product holder further comprising a removable cap with a clip at an inhalation opening side of the holder body and a removable lid at a tobacco product insertion opening side of the holder body.

Item 12. A nicotine-reducing smoking article according to Item 11, wherein the filter retains a nicotine-reducing agent according to Item 1.

Item 13. A method of reducing the nicotine content of the mainstream smoke of a tobacco product, the method comprising the step of passing the mainstream smoke of a tobacco product through a filter of a smoking article, the filter containing a nicotine-reducing agent according to Item 1.

Use of the aqueous liquid composition (nicotine-reducing agent) of the present invention reduces not only the nicotine content but also the tar content of the mainstream smoke of a tobacco product, as shown in Experimental Example 4 described hereinafter. Therefore, the above "nicotine-reducing agent" and "nicotine-reducing smoking article" can also be said to be a "tar-reducing agent" and "tar-reducing smoking article", respectively, or a "nicotine- and tar-reducing agent" and "nicotine- and tar-reducing smoking article", respectively. From the viewpoint of tar reduction, the present invention provides the following methods.

Item 14. A method for reducing the tar content of the mainstream smoke of a tobacco product, the method

comprising the step of passing the mainstream smoke of a tobacco product through a filter of a smoking article, the filter containing an aqueous liquid composition (tar-reducing agent) having a viscosity of 500 to 3000 mPa·s and containing at least one polysaccharide selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carageenan.

Further, as described above, use of the nicotine-reducing agent (aqueous liquid composition) of the present invention makes it possible to reduce the nicotine dependence of a smoker. From such a viewpoint, the present invention provides the following methods.

Item 15. A method for reducing nicotine dependence of a subject with a smoking habit, the method comprising causing the subject to smoke using a smoking article comprising a filter containing an aqueous liquid composition (nicotine-reducing agent), the aqueous liquid composition having a viscosity of 500 to 3000 mPa·s and containing at least one polysaccharide selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carageenan.

Furthermore, the present invention provides the following uses of the aqueous liquid composition of the present invention.

Item 16. Use of an aqueous liquid composition having a viscosity of 500 to 3000 mPa·s and containing at least one polysaccharide selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose,

hydroxypropylmethylcellulose and carageenan, for preparing a nicotine-reducing and/or tar-reducing agent.

Item 17. Use according to Item 16, wherein the aqueous liquid composition further comprises at least one saccharide.

Item 18. Use according to Item 17, wherein said at least one saccharide is selected from the group consisting of trehalose, starch syrup, sucrose, glucose, fructose, maltose, sorbitol, maltitol, lactitol, erythritol, xylitol and dextrin.

Item 19. Use of an aqueous liquid composition having a viscosity of 500 to 3000 mPa·s and containing at least one polysaccharide selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carageenan, for reducing nicotine and/or tar.

Item 20. Use according to Item 19, wherein the aqueous liquid composition further comprises at least one saccharide.

Item 21. Use according to Item 20, wherein said at least one saccharide is selected from the group consisting of trehalose, starch syrup, sucrose, glucose, fructose, maltose, sorbitol, maltitol, lactitol, erythritol, xylitol and dextrin.

BRIEF DESCRIPTION OF THE DRAWINGS

[Fig. 1] A plan view showing the appearance of a cigarette holder 1 in accordance with one embodiment of the nicotine-reducing smoking article of the present invention.

[Fig. 2] A plan view showing the appearance of a cigarette holder 11 in accordance with another embodiment of the nicotine-reducing smoking article of the present invention.

[Fig. 3] A side view of the cigarette holder 11 shown in Fig. 2.

[Fig. 4] A cross section taken along the line III-III shown in Fig. 2.

[Fig. 5] A cross section taken along the line IV-IV shown in Fig. 3.

[Fig. 6] A side view showing the cigarette holder 11 of Fig. 2 having a lid 77 attached to a cap 66 with a clip.

[Fig. 7] A vertical cross section of Fig. 6.

[Fig. 8] A chart showing nicotine and tar reduction percentages achieved by using the nicotine-reducing agent (aqueous liquid composition) of the present invention (Experimental Example 4).

EXPLANATIONS OF REFERENCE NUMERALS

1. Cigarette holder as an embodiment of the nicotine-reducing smoking article of the present invention
2. Filter (retention portion)
3. Holder body
4. Inhalation opening
5. Cigarette insertion opening
6. Cap with a clip
7. Lid
8. Projection for inserting the cap with a clip into the inhalation opening
9. Opening of the cap with a clip
10. Rim
11. Cigarette holder as another embodiment of the nicotine-reducing smoking article of the invention

BEST MODE FOR CARRYING OUT THE INVENTION

(1) Nicotine-reducing agent

The nicotine-reducing agent of the invention which is an aqueous liquid composition containing at least one polysaccharide selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum,

pectin, pullulan, phyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carrageenan.

Tamarind seed gum is an aqueous polyssacharide obtainable from seeds of *Tamarindus grandiflora* Pers. which is a perennial dicotyledon of the Fabaceous family. Locust bean gum is a polysaccharide obtainable from seeds of *Ceratonia siliqua* Linne. Xantham gum is a fermented polysaccharide produced by the microorganism *Xanthomonas campestris*. Tara gum is an aqueous polysaccharide obtainable from seeds of *Actinidia callosa* Lindl. Guar gum is a polysaccharide obtainable from *Cyamopsis tetragonoloba* Taub. or an enzymatically (e.g. hemicellulase, etc.) degraded product of said polysaccharide. Pectin is a polysaccharide extractable from citrus fruits and apples using water, and has methylated polygalacturonic acid as a principle component. Pectin can broadly be classified into HM pectin (50 % or more methylated galacturonic acids out of the total galacturonic acid content) and LM pectin (below 50 %) methylated galacturonic acids out of the total galacturonic acid content), based on its degree of esterification (methoxyl group content). HM pectin and LM pectin can be both used in the present invention.

Pullulan is a polysaccharide produced by *Aureobasidium pullulans* [DE Bary] Arn.). Psyllium seed gum is a polysaccharide obtainable from seeds of *Plantago ovata* Forsk. and other plants of the same genus. Carrageenan is a polysaccharide extracted using water from fronds of *Chondrus crispus* Lyngb., *Gigartina tenella* Harv., *Eucheuma muricatum* W. v. Bosse forma depaupaerata W. v. Bosse, *Hypnea japonica* Tanaka, and the like. Carrageenan can be classified into three main categories, kappa (κ), iota (ι) and lambda (λ), and any of κ-carrageenan, ι-carrageenan and λ-carrageenan can be used in the invention, with λ-carrageenan being preferable.

These polysaccharides, as well as methylcellulose,

carboxymethylcellulose and hydroxypropylmethylcellulose, are commonly commercialized and used as food additives such as thickening agents, thickening stabilizers, and the like. The present invention may also use, with no limitation, conventional commercial food additives including tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethycellulose, hydroxypropylmethylcellulose and carrageenan.

Preferable polysaccharides among these are tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum and pectin, and particularly preferable are tamarind seed gum, locust bean gum and xanthan gum.

The nicotine-reducing agent of the invention that is an aqueous liquid composition having a viscosity of 500 to 3000 mPa・s. The viscosity used herein is measured using a B-type rotational viscometer (a No. 3 rotor is used for a viscosity of 2000 mPa・s or lower, and a No. 4 rotor for a viscosity above 2000 mPa・s) at 20 °C at 60 rpm for one minute. The viscosity is preferably 500 to 2500 mPa・s, and more preferably 1000 to 2500 mPa・s.

The method for adjusting the aqueous liquid composition to have a viscosity as mentioned above is not limited, and the viscosity may be adjusted by suitably selecting the solvent(s) for dissolving the above polysaccharides, adjusting the ratios of polysaccharides to be used, mixing in other components, and/or the like.

Solvents used for dissolving tamarind seed gum, xanthan gum, locust bean gum, and like polysaccharides mentioned above are not limited as long as they are capable of dissolving these substances. In light of safety and convenience, a preferable solvent is water. Water may also be used in combination with ethanol, propylene glycol, glycerol, etc. in a range in which the effects of the invention are not impaired.

The above polysaccharides (tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carrageenan) can be used singly as an active ingredient for the nicotine-reducing agent of the invention, or two or more may be used in combination, as desired. Preferable combinations of these polysaccharides are not limited, and examples are tamarind seed gum and locust bean gum, tamarind seed gum and xanthan gum, locust bean gum and methylcellulose, tamarind seed gum and tara gum, and tamarind seed gum and guar gum.

The proportion of the above polysaccharides (tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose or carrageenan) in the nicotine-reducing agent (aqueous liquid composition) is not limited, as long as the nicotine-reducing agent (aqueous liquid composition) to be obtained has the above-specified viscosity from 500 to 3000 mPa · s, preferably from 500 to 2500 mPa · s, and more preferably 1000 to 2500 mPa · s.

For example, proportions of each polysaccharide that may be used in 100 wt.% of nicotine-reducing agent (aqueous liquid composition) are shown in Table 1.

Table 1

(weight %)

	Typical proportion	Preferable proportion	More preferable proportion
Tamarind seed gum	1.5 - 3.0	1.5 - 2.5	2.0 - 2.5
Locust bean gum	0.5 - 1.5	0.5 - 1.25	0.75 -
Xanthan gum	0.5 - 3.0	0.5 - 2.5	1.0 - 2.5
Tara gum	0.5 - 1.2	0.5 - 1.0	0.6 - 1.0
Guar gum	0.5 - 1.5	0.5 - 1.25	0.75 -
Pectin	4.0 - 10.0	4.0 - 8.0	5.0 - 8.0
Pullulan	15.0 -	15.0 -	17.5 -
Psyllium seed gum	0.6 - 2.0	0.6 - 1.75	0.75 -
Methylcellulose	2.0 - 4.0	2.0 - 3.5	2.5 - 3.5
Carboxymethylcellulose	1.5 - 3.0	1.5 - 2.5	2.0 - 2.5
Hydroxypropylmethylcellulose	2.0 - 5.0	2.0 - 4.0	3.0 - 4.0
Carrageenan	1.0 - 2.5	1.0 - 2.25	1.5 - 2.25

When using any two or more of these components in combination, the ratio and amount of the combination can be determined, based on the above mixing proportions as a guideline, to adjust the viscosity so that the nicotine-reducing agent (aqueous liquid composition) has a viscosity from 500 to 3000 mPa・s, preferably from 500 to 2500 mPa・s, and more preferably 1000 to 2500 mPa・s. As mentioned above, for the combined use of tamarind seed gum and locust bean gum, the ratio can be, for example, 0.1 to 10 parts by weight, and preferably 0.2 to 5 parts by weight, of locust bean gum per part by weight of tamarind seed gum. For the combined use of tamarind seed gum and xanthan gum, the ratio can be 0.02 to 1 parts by weight, and preferably 0.05 to 0.5 parts by weight of xanthan gum per part by weight of tamarind seed gum. For the combined use of methylcellulose and locust bean gum, the ratio can be 0.2 to 20 parts by weight, and preferably 0.5 to 10 parts by weight of locust bean gum per part by weight of methylcellulose. Further, for the combined use of tamarind seed gum and tara gum, the ratio can be 0.1 to 10 parts by

weight, and preferably 0.2 to 5 parts by weight of tara gum per part by weight of tamarind seed gum. For the combined use of tamarind seed gum and guar gum, the ratio can be 0.1 to 10 parts by weight, and preferably 0.2 to 5 parts by weight of guar gum per part of tamarind seed gum.

In addition to at least one polysaccharide selected from the group consisting of the above-mentioned tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carrageenan, the nicotine-reducing agent of the invention can contain other saccharides within the range in which effects of the invention are not impaired. When such saccharides are used in combination with the above-mentioned polysaccharides, it is possible to enhance the viscosity and viscosity stability as well as the nicotine and tar reduction percentage.

Preferable examples of such saccharides for use in the invention include glucose, fructose, galactose, mannose, xylose, erythrose, and like monosaccharides, and reducing sugars thereof (e.g. sorbitol, xylitol, erythritol); trehalose, maltose, isomaltose, nigerose, cellobiose, sucrose, lactose, and like disaccharides, and reducing sugars thereof (e.g. maltitol, lactitol); beet oligosaccharide, maltooligosaccharide, isomaltooligosaccharide, fructooligosaccharide, galactooligosaccharide, xylooligosaccharide, lacto-sucrose oligosaccharide, and like oligosaccharides, and reducing sugars thereof; and dextrin, starch syrup, and like saccharides derived from starch, and reducing sugars thereof (e.g. reduced starch syrup).

Preferable examples include glucose, fructose, and like monosaccharides, and reducing sugars thereof (sorbitol, xylitol, erythritol); trehalose, maltose, sucrose, and like disaccharides, and reducing sugars thereof (maltitol, lactitol); dextrin, and starch syrup. Especially preferable

are glucose and its reducing sugar (sorbitol); maltose and its reducing sugar (maltitol); trehalose; dextrin and starch syrup and like starch-derived saccharides (monosaccharides, oligosaccharides, and reducing products thereof obtained by enzymatic or acidic degradation, enzymatic transfer and enzymatic bonding of starch), and particularly preferable are sorbitol, trehalose, and starch syrup.

These saccharides can be used singly with the above-mentioned polysaccharides, or two or more of any saccharide can be used in combination. Examples of preferable combinations are trehalose and starch syrup, sorbitol and starch syrup, etc.

The proportion of these saccharides in the nicotine-reducing agent (100 wt.%) of the invention is not limited, but can be selected based on an adjusted viscosity so that the nicotine-reducing agent has a final viscosity ranging from 500 to 3000 mPa・s, preferably 500 to 2500 mPa・s, and more preferably 1000 to 2500 mPa・s. For example, when starch syrup and/or reduced starch syrup are used as saccharides, the proportion of these saccharides is usually from 5 to 60 wt.%, preferably 10 to 50 wt.%, and more preferably 10 to 40 wt.%. When saccharides other than these are used, the proportion of these saccharides is usually, for example, 5 to 50 wt.%, preferably 10 to 40 wt.%, and more preferably 10 to 30 wt.%.

In addition to the above components (polysaccharides and saccharides), the nicotine-reducing agent of the invention may optionally contain components having thickening properties within ranges in which the effects of the invention are not impaired. Examples of such thickening components include cassia gum, glucomannan, deacylation-type gellan gum, native-type gellan gum, *Bacillus natto* gum, hydroxypropylcellulose (HPC), polyvinyl pyrrolidone (PVP), alginate, alginic acid propylene glycol ester, gum arabic, tragacanth gum, ghatti gum, soybean

polysaccharide, macrophomopsis gum, rhamsan gum, welan gum, karaya gum, starch, modified starch, chemically-modified starch, fermentation-derived cellulose, agar, and like thickening components. Such components can be used singly, or any two or more can be used in combination. It is desirable that such components be water soluble. Preferable are gum arabic, soy bean polysaccharide, and karaya gum.

Further, in addition to the above components (polysaccharides and saccharides), the nicotine-reducing agent of the invention may optionally contain other components within ranges in which the effects of the invention are not impaired. Examples of such components include sweeteners (e.g. sucralose, aspartame, acesulfame potassium, saccharin, and like high-intensity sweeteners), natural and synthetic food colorings, perfumes, acidulants (e.g. citric acid, tartaric acid, ascorbic acid, and like organic acids), preservatives (e.g. sodium benzoate, potassium sorbate, etc.), antioxidants (e.g.tea catechin, anthocyanin, isoflavone, and like polyphenols), herbs and extracts therefrom (chamomile, *Aloe arborescens* Mill, *Echinacea*, hop (*Humulus lupulus*), melissa (*Melissa officinalis*), etc.), amino acids, minerals and vitamins, etc. It is also desirable that these components be water soluble.

The nicotine-reducing agent of the invention can be prepared by dissolving in an aqueous solvent at least one polysaccharide as an active ingredient selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carrageenan, or a combination of at least one of these polysaccharides and at least one of the above-mentioned saccharides, or optionally added any of the above-mentioned components. The dissolution may be carried out at warm temperatures or with stronger heating.

The pH of the nicotine-reducing agent of the invention is not limited, and any value may be selected, with typical examples being weakly acidic with pH 3 to 5, and particularly pH 3.5 to 4.5.

The thus-prepared nicotine-reducing agent (aqueous liquid composition) of the invention is used while being retained in a filter of a smoking article. The accommodation method is not limited, and the nicotine-reducing agent (aqueous liquid composition) of the present invention may be supplied in a liquid form into the filter (e.g. infiltration), and accommodated in the filter in either a wet or dried state. In view of nicotine removing effects, it is preferable that the agent be accommodated in a wet state (infiltration).

Specific examples of filter of smoking articles include filters at cigarette ends and filters in tobacco pipes and cigarette holders (placed at the inhalation end of a cigarette in use).

The method of accommodating the nicotine-reducing agent (aqueous liquid composition) in the filter of a smoking article is not limited. For examples, a filter of a smoking article may be directly immersed in the nicotine-reducing agent (aqueous liquid composition), or a filter may be coated with the nicotine-reducing agent (aqueous liquid composition). However, it is hygienically desirable that one (about 50 mg) to several drops, and preferably one to five drops, of the nicotine-reducing agent (aqueous liquid composition) be dropped into the filter of a smoking article.

When the nicotine-reducing agent (aqueous liquid composition) of the invention is dropped onto a filter as mentioned above, it is preferable, but not limited, that the agent form droplets easily. Further, when the nicotine-reducing agent (aqueous liquid composition) of the invention is used in a filter, it is preferable, but not limited, that the agent is readily penetrated to be contained, and preferably spread throughout the filter. Furthermore, when

retained in the filter of a smoking article and the article is sucked, it is preferable that the nicotine-reducing agent (aqueous liquid composition) of the invention does not cause problems such as sucking difficulties due to elevated suction pressure or splashing of the agent from the filter into the mouth.

The nicotine-reducing agent (aqueous liquid composition) of the invention can provide the above characteristics when comprising at least one polysaccharide selected from the group consisting of tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pectin, pullulan, psyllium seed gum, methylcellulose, carboxymethylcellulose, hydroxypropylmethylcellulose and carrageenan, optionally combined with saccharides as mentioned earlier, and prepared into an aqueous liquid composition having a viscosity of 500 to 3000 mPa · s, preferably 500 to 2500 mPa · s, and more preferably 1000 to 2500 mPa · s. The nicotine-reducing agent (aqueous liquid composition) of the invention advantageously having diminished viscosity changes caused by temperature and/or storage conditions has a stable viscosity and other properties throughout the year. Given this, the viscosity does not remarkably increase during low winter temperatures but maintains such a viscosity that the dropping and penetration into the filter and smoking (suction) can be done without inconvenience.

The nicotine-reducing agent (aqueous liquid composition) of the invention is intended to be usually sold as being filled in a container. The container for accommodating the nicotine-reducing agent is not limited; however as mentioned above, since dripping is the preferable manner for using the nicotine-reducing agent of the invention, the agent is desirably filled in a dropping pipette-type container (e.g. such as a dropper). The dropping pipette-type container is not limited, as long as it is provided with

a member by which the liquid content (aqueous liquid composition) can be applied drop by drop. Usable examples include containers whose entire body is a dropping pipette and capable of directly dripping the contents (aqueous liquid composition) from its opening, those with a cap functioning as a dropping pipette by which the contents can be sucked out and dripped, etc.

The size (volume) of a container for accommodating the nicotine-reducing agent is not limited, but in view of the purpose of the invention, dosage, and portability, it is desirable that the container accommodate contents of usually 1 to 100 ml, and preferably 2 to 20 ml.

(2) Nicotine-reducing smoking articles

The present invention provides nicotine-reducing smoking articles. Examples of nicotine-reducing smoking articles of the invention include smoking articles such as filtered cigarettes, etc. (hereinafter simply referred to "cigarettes" so as to distinguish these from tools used for smoking as mentioned below); and tools used for smoking tobacco products (e.g., paper-wrapped tobaccos, shredded tobaccos, cigars, etc.) such as smoking pipes (including long-stemmed pipes such as Japanese pipe "kiseru"), cigarette holders (used by being placed onto the mouth end of cigarettes, for example, disposable cigarette holders), cartridges mounted in cigarette holders, etc. (hereinafter simply referred to as "pipes" so as to distinguish these from the above-defined cigarettes).

A pipe as referred to herein comprises at least a tobacco-accommodating portion or tobacco insertion opening, an inhalation opening, and a passage (tube) for passing smoke from the tobacco-accommodating portion or tobacco insertion opening to the inhalation opening, and a region (retention portion) for retaining the nicotine-reducing agent (aqueous liquid composition) of the invention.

The smoking article of the invention is a nicotine-reducing smoking article in which the nicotine-reducing agent (aqueous liquid composition) of the invention is accommodated in the filter of a filtered cigarette or the retention portion of a pipe, thereby reducing the amount of nicotine inhaled into the body during smoking.

There are no particular structural or material limitations on the retention portion of the pipe, as long as the retention portion is disposed so that the mainstream smoke of a tobacco product passes therethrough, and is configured in such a manner that the nicotine-reducing agent (aqueous liquid composition) of the invention can be retained therein. The retention portion can be formed, for example, by attaching a porous member made of paper, nonwoven fabric, fiber, sponge, etc. to or filling such a member into a portion through which the mainstream smoke of a tobacco product passes. Examples of retention portion materials include but are not limited to cellulose acetate, fatty acid polyester compounds, cellulose esters, etc.

The pipe (smoking article) of the invention achieves nicotine-removing effects by passing the mainstream smoke of a tobacco product through the retention portion in which the nicotine-reducing agent (aqueous liquid composition) is accommodated. Therefore, the retention portion of the pipe can also be defined as a filter. In this sense, in this specification, the retention portion of pipes and the filter of cigarettes may sometimes be referred to together as a "smoking article filter".

The capacity of the smoking article filter of the invention (filter of cigarettes, retention portion of pipes) is not particularly limited. Preferably, the filter has a capacity capable of retaining as much nicotine-reducing agent (aqueous liquid composition) as possible in a stable manner. However, if the filter has a capacity capable of retaining at least about 50 to about 250 mg, and preferably about 50 to

about 150 mg, of the nicotine-reducing agent (aqueous liquid composition), this is sufficient for normal use.

Fig. 1 illustrates a cigarette holder 1 and Figs. 2 to 7 illustrate a cigarette holder 11 as embodiments of the nicotine-reducing smoking article of the invention; however, the invention is not limited thereto.

The cigarette holder 1 comprises a holder body 3 in which a filter 2, i.e., a retention portion, is provided to retain the nicotine-reducing agent of the invention. The holder body 3 has an inhalation opening 4 at one end and a cigarette insertion opening 5 at the other end. In the holder body 3, the periphery and vicinity of the inhalation opening 4 are flattened to facilitate the cigarette holder being held between the lips. The cigarette holder 1 shown as one embodiment of the nicotine-reducing smoking article of the invention is configured in such a manner that the nicotine-reducing agent of the invention is retained beforehand in the filter.

Similarly, the cigarette holder 11 comprises a holder body 3 in which a filter 2, i.e., a retention portion, is provided to retain the nicotine-reducing agent of the invention. The cigarette holder 11 shown as a nicotine-reducing smoking article of the invention may be configured in such a manner that the nicotine-reducing agent of the invention is retained in the filter 2 beforehand or placed and retained in the filter at the time of use.

The structure of the cigarette holder 11 is described below with reference to Figs. 2 to 7.

The holder body 3 has an inhalation opening 4 at one end and a cigarette insertion opening 5 at the other end. In the holder body 3, the periphery and vicinity of the inhalation opening 4 are flattened to facilitate the cigarette holder being held between the lips. In the cigarette holder 11, one end of the holder body 3 may further be provided with a cap 6 with a detachable clip, and the

other end a detachable lid 7. In the embodiment shown in the Figs., the cap 6 with the clip is attached to the inhalation opening 4 end of the holder body 3, and the lid 7 to the cigarette insertion opening 5 end of the holder body 3. The cap 6 with the clip has a projection 8 for insertion into the inhalation opening 4.

Attachment of the cap 6 with the clip and the lid 7 to the holder body 3 can prevent volatilization during the infiltration of the nicotine-reducing agent into the filter 2. When not smoking, the clip of the cap 6 can be fastened onto a breast pocket, etc. The cap 6 with the clip is preferably configured to be similar to those attached to typical pens.

The cap 6 with the clip and the lid 7 are configured to be attachable and detachable. In the embodiment shown in the Figs., attachment can be made by engaging the lid 7 with the opening 9 of the cap 6 with the clip. The lid 7 has a collar 10 that acts as a stopper when the lid 7 is engaged with the cap 6 with the clip. When smoking, the lid 7 is attached to the cap 6 with the clip and the clip is fastened onto a breast pocket, etc., thereby preventing loss of the lid 7.

(3) Method for reducing the nicotine content of the mainstream smoke of a tobacco product

The present invention provides a method for reducing the nicotine content of the mainstream smoke of a tobacco product. The method can be carried out by infiltrating the nicotine-reducing agent (aqueous liquid composition) into a smoking article filter (e.g., a cigarette filter or a filter of a smoking pipe or cigarette holder) and passing the mainstream smoke of a tobacco product through the filter when smoking.

According to the method of the invention for reducing the nicotine content, the nicotine content of the mainstream smoke inhaled into the body can be significantly

reduced by simply infiltrating the nicotine-reducing agent (aqueous liquid composition) of the invention into a smoking article filter. As shown in the Experimental Examples below, not only can the nicotine content of the mainstream smoke of a tobacco product be significantly reduced but also the tar content. Thus the present invention also provides a method for reducing the tar content of the mainstream smoke of a tobacco product.

As shown in the Experimental Examples, increasing the amount of nicotine-reducing agent (aqueous liquid composition) in the filter leads to a greater reduction in the nicotine content and tar content of the mainstream smoke, in proportion to the increase of nicotine-reducing agent. The volume of nicotine-reducing agent (aqueous liquid composition) retained in the filter is not particularly limited as long as it can be successfully retained in the filter. For example, it is usually a volume equivalent to 1 to several drops (about 50 mg to about several hundred mg), and preferably a volume equivalent to 1 to 5 drops (about 50 mg to about 250 mg).

The main reason that it is difficult to quit smoking is considered to be the physical and psychological dependence on the nicotine contained in the mainstream smoke of tobacco products. The nicotine-reducing method of the invention enables smokers to reduce the amount of nicotine inhaled into the body while smoking, thereby gradually reducing their nicotine dependence. According to the nicotine-reducing agent of the invention, smokers can adjust the amount of nicotine-reducing agent (the amount contained in the filter) by themselves, thereby controlling the nicotine content of the mainstream smoke inhaled. Therefore, smokers can gradually reduce their nicotine intake according to their nicotine dependence status and ultimately eliminate their nicotine dependence, thereby successfully quitting smoking.

EXAMPLES

Hereafter, the present invention will be described more specifically with reference to the following Experimental Examples and Examples, but the invention is not limited thereto. In the following Experimental Examples and Examples, parts are all parts by weight unless otherwise specified.

The products used in the following Examples were obtained as follows. The products marked "*" are registered trade marks of San-Ei Gen F.F.I., Inc in Japan.

Tamarind seed gum: VIS TOP* D-2033, San-Ei Gen F.F.I., Inc.

Locust bean gum: VIS TOP* D-30, San-Ei Gen F.F.I., Inc.

Xanthan gum: SAN ACE* C, San-Ei Gen F.F.I., Inc.

Tara gum: VIS TOP* D-2101, San-Ei Gen F.F.I., Inc.

Guar gum: VIS TOP* D-2029, San-Ei Gen F.F.I., Inc.

Pullulan: Pullulan PF-20 (fine particles), Hayashibara Co. Ltd.

Psyllium seed gum: SOALLYUM PG-200, MRC Polysaccharide Co.,Ltd.

HM pectin: VIS TOP* D-2220, San-Ei Gen F.F.I., Inc.

LM pectin: VIS TOP* D-402, San-Ei Gen F.F.I., Inc.

λ-carageenan: CARRAGEENAN CSL-1, San-Ei Gen F.F.I., Inc.

Trehalose : Treha fine particles (tradename), Hayashibara Co., Ltd.

Starch syrup (acid-saccharification starch syrup): Syrup low (tradename), Kogo Starch Co. Ltd.

Soybean polysaccharide: SM-920 (tradename), San-Ei Gen F.F.I., Inc.

Trisodium citrate: Trisodium citrate F (tradename) San-Ei Gen F.F.I., Inc.

Glycine: Glycine P (tradename), Yuki Gosei Kogyo Co., Ltd.

L-ascorbic acid: Viscorin 80M (tradename), Daiichi Fine-chemicals, Co., Ltd.

Tea catechin: SD green tea extract powder, NO.16714, San-Ei Gen F.F.I., Inc.

Licorice powder : LICOZIN P-1 (tradename), Ikedatohka Industries Co., Ltd.

Experimental Example 1

(1) Preparation of aqueous liquid composition

Aqueous liquid compositions (Examples 1-15) were prepared according to the formulations shown in Table 2. More specifically, one or more of the polysaccharides shown in Table 1 (tamarind seed gum, locust bean gum, xanthan gum, tara gum, guar gum, pullulan, psyllium seed gum, HM pectin, LM pectin, λ-carageenan, carboxymethylcellulose) together with trehalose were added to ion-exchanged water, and the mixture was dissolved by stirring while heating at 80°C for 10 minutes, however methylcellulose (Example 14) and hydroxypropylmethylcellulose (Example 15) were added together with trehalose to ion-exchanged water, and the mixture was dissolved by stirring at 60°C for 10 minutes and further stirring at 10°C for 10 minutes.

To each solution were added an aqueous solution of sodium benzoate, an aqueous solution of citric acid, an aqueous solution of trisodium citrate, and an aqueous solution of colorant (red No. 2, red No. 40), these aqueous solutions having been prepared by dissolution in ion-exchanged water beforehand, and then mixed. The total amount of each mixture was adjusted with ion-exchanged water to be 100% by weight, preparing aqueous liquid compositions (Examples 1-15).

(2) Property evaluation of aqueous liquid compositions

The viscosity (initial viscosity) of each aqueous liquid composition (Examples 1-15) obtained above was measured using a B-type rotational viscometer (Rotor No.3 was used when the viscosity was 2000 mPa·s or lower, and Rotor No.4 was used when the viscosity was above 2000 mPa·s) at 20°C at 60 rpm for 1 minute. The aqueous liquid

compositions were stored at 50°C for three weeks, and the viscosity (viscosity after storage) was measured under the same conditions as above. The residual viscosity(%) was calculated using the following equation, and the viscosity stability was evaluated in accordance with the following criteria.

Residual viscosity (%) = (viscosity after storage/initial viscosity) × 100

<Viscosity stability>

Residual viscosity(%)	Evaluation	Score
81% or higher	◎	9
61% to 80%	○	6
41% to 60%	△	3
40% or lower	×	0

(3) Sensory evaluation

The aqueous liquid compositions (Examples 1-15) obtained above were adjusted to 20°C, and two drops (about 100 mg) of one of each of the aqueous liquid composition were then added to a single tobacco product filter tip. The time taken for the liquid to penetrate into each filter was measured (evaluation of liquid penetration ability). The penetration was judged to be complete when the liquid drops adhering to the filter surface had completely disappeared. After confirming that the liquid had penetrated into each filter, it was evaluated by smoking each tobacco product to determine whether or not the liquid was drawn into a mouth when the smoke of each tobacco product was inhaled (evaluation of liquid drawing property). The aqueous liquid compositions (Examples 1-15) were evaluated by the same person for the liquid penetration ability and the liquid drawing property in accordance with the following criteria. The liquid drawing property was evaluated by inhaling mainstream smoke three times.

<Liquid penetration ability into a filter>

Time taken for penetration	Evaluation	Score
10 seconds or less	◎	6
11 to 30 seconds	○	4
31 to 60 seconds	△	2
61 seconds or less	×	0

<Liquid drawing property>

Liquid drawing property level	Evaluation	Scores
Substantially none	◎	3
Slight	○	2
Some	△	1
Clearly observed	×	0

(4) Results

The evaluation results obtained in (2) and (3) above are also shown in Table 2. The results evaluated based on the results obtained in (2) and (3) above according to the following criteria are also shown in Table 2 as a comprehensive evaluation.

<Comprehensive Evaluation >

Total of scores	Evaluation
15 to 18	◎
11 to 14	○
7 to 10	△
0 to 6	×

Table 2

Ingredients and Evaluation items	Amount (%) and Evaluation results														
	Examples														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tamarind seed gum	1.8			1.4	1.4										
Locust bean gum		1.0		0.2											
Xanthan gum			1.2		0.2										
Tara gum						0.7									
Guar gum							1.0								
Pullulan								18							
Psyllium seed gum									0.8						
HM pectin										4.0					
LM pectin											4.5				
λ-carageenan												1.6			
Carboxymethylcellulose													1.8		
Methylcellulose														2.5	
Hydroxypropylmethylcellulose															3.0
Trehalose	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Sodium benzoate	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Citric acid	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Trisodium citrate	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Red No. 2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Red No. 40	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Viscosity (60 rpm)	1890	1480	1850	1920	1510	1440	1780	2300	1320	1280	1080	1020	2640	1220	1530
Solution pH	3.60	3.59	3.89	3.56	3.69	3.60	3.59	3.91	3.73	3.59	4.46	4.50	3.92	3.60	3.58
Liquid penetration ability into a filter *1	○	○	△	○	○	○	○	○	△	○	◎	◎	△	○	△
Liquid drawing property *2	◎	○	△	◎	○	△	△	◎	◎	△	△	△	◎	◎	◎
Viscosity stability *3	○	○	◎	○	◎	△	△	△	◎	△	△	△	○	△	△
Comprehensive evaluation*4	○	○	○	○	◎	△	△	△	○	△	△	△	○	△	△

Experimental Example 2

(1) Preparation of an aqueous liquid composition

Aqueous liquid compositions (Examples 16-25) were prepared according to the formulations shown in Table 3. More specifically, tamarind seed gum, xanthan gum and one of the saccharides shown in Table 3 (trehalose, sucrose, glucose, fructose, maltose, sorbitol, maltitol, erythritol, xylitol, dextrin) were added to ion-exchanged water, and each mixture was dissolved by stirring while heating at 80°C for 10 minutes. To each solution were added an aqueous solution of sodium benzoate, an aqueous solution of citric acid, an aqueous solution of trisodium citrate, and an aqueous solution of colorant (red No. 2, red No. 40), these solutions having been dissolved in ion-exchanged water beforehand, and then mixed. The total amount of each mixture was adjusted with ion-exchanged water to be 100% by weight, preparing aqueous liquid compositions (Examples 16-25).

(2) Property evaluation of aqueous liquid compositions

In the same manner as in Experimental Example 1, the initial viscosity of each aqueous liquid composition (Examples 16-25) obtained above was measured. Separately, in the same manner as in Experimental Example 1, the viscosity after storage at 50°C for three weeks (viscosity after storage) was measured to calculate the residual viscosity(%), and the viscosity stability of each aqueous liquid composition was evaluated.

(3) Sensory evaluation

In the same manner as in Experimental Example 1(3), one of each of the aqueous liquid compositions (Examples 16-25, adjusted to 20°C) obtained above was added to a single tobacco product filter tip. The liquid penetration ability into each filter (evaluation of penetration ability) was evaluated. In the same manner, it was evaluated whether or not the liquid was drawn into a mouth when each tobacco product was smoked (evaluation of liquid drawing property).

(4) Results

The evaluation results obtained in (2) and (3) above are shown in Table 3.

The results evaluated based on the results obtained in (2) and (3) above according to the same criteria as in Experimental Example 1 are also shown in Table 3 as a comprehensive evaluation.

Table 3

Ingredients and Evaluation items	Amount (%) and Evaluation results									
	Examples									
	16	17	18	19	20	21	22	23	24	25
Tamarind seed gum	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Xanthan gum	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Trehalose	25									
Sucrose		25								
Glucose			25							
Fructose				25						
Maltose					25					
Sorbitol						25				
Maltitol							25			
Erythritol								25		
Xylitol									25	
Dextrin										25
Sodium benzoate	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Citric acid	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Trisodium citrate	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Red No. 2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Red No. 40	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Viscosity (60 rpm)	1590	1710	1440	1510	1640	1560	1800	1490	1490	1140
Solution pH	3.62	3.58	3.56	3.67	3.60	3.70	3.66	3.66	3.69	3.74
Liquid penetration ability into a filter *1	○	○	○	○	○	○	○	○	○	△
Liquid drawing property *2	◎	◎	◎	◎	◎	◎	◎	◎	◎	△
Viscosity stability *3	◎	◎	◎	△	◎	○	◎	○	◎	◎
Comprehensive evaluation*4	◎	◎	◎	△	◎	○	◎	○	◎	○

Experimental Example 3

(1) Preparation of an aqueous liquid composition

Aqueous liquid compositions (Examples 26-29) were prepared by the following procedure according to the formulations shown in Table 4. The viscosity of each aqueous liquid composition obtained above was measured using a B-type rotational viscometer (Rotor No.3) at 20°C at 60 rpm for 1 minute.

(i) Example 26

Locust bean gum was added in small portions to room temperature water while stirring, followed by heating. After reaching 90°C, the mixture was dissolved by further stirring at 90°C for 10 minutes. Subsequently, trehalose was added to the mixture, followed by further stirring. Methylcellulose was added in small portions to the mixture, and the mixture was cooled to 20°C. To the mixture were added citric acid, glycine, L-ascorbic acid, tea catechin, trisodium citrate, licorice powder, and a colorant. The citric acid, glycine, L-ascorbic acid, and tea catechin were dissolved in small amounts of water before mixing. With respect to trisodium citrate and licorice powder, trisodium citrate was dissolved in a small amount of water, and licorice powder was then added to the solution and dissolved before use. After preparation, the total amount (100% by weight) of the mixture was adjusted with water. The adjusted solution was put in a container, followed by heat pasteurization at 65°C for 10 minutes, providing an aqueous liquid composition (Example 26).

(ii) Example 27

Tamarind seed gum and xanthan gum were added in small portions to 80°C water while stirring, and the mixture was dissolved by stirring at 80°C for 10 minutes (Solution A). Separately, a mixed powder of soybean polysaccharide and trehalose was added in small portions to 80°C water while stirring, and the mixture was dissolved at 80°C. To this solution were added glycine, adipic acid, L-ascorbic acid, and tea catechin. A solution obtained by adding licorice powder to trisodium citrate dissolved in a small amount of water and dissolving was further added, and a colorant was added (Solution B). Solution A, Solution B, and starch syrup were mixed by stirring, and the total amount (100% by weight) of the mixture was then adjusted with water. The adjusted solution was placed in a container, followed by heat pasteurization at 65°C for 10 minutes, providing an aqueous liquid composition (Example 27).

(iii) Example 28

The procedure of Example 27 was followed except for using no xanthan gum, giving an aqueous liquid composition (Example 28).

(iv) Example 29

The procedure of Example 27 was followed except for using no tamarind seed gum, giving an aqueous liquid composition (Example 29).

Table 4

Starting material	Ex. 26	Ex. 27	Ex. 28	Ex. 29
Tamarind seed gum	-	1.2	1.5	-
Locust bean gum	0.7	-	-	-
Xanthan gum		0.2	-	1.0
Methylcellulose	0.4	-	-	-
Treharose	28.0	21.0	21.0	21.0
Starch syrup	-	10.0	10.0	10.0
Soybean polysaccharide	-	1.0	1.0	1.0
Citric acid	0.25	-	-	-
Trisodium citrate	0.05	0.05	0.05	0.05
Glycine	0.05	2.0	2.0	2.0
Adipic acid	-	0.55	0.55	0.55
L-ascorbic acid	0.05	0.1	0.1	0.1
Tea catechin	0.05	0.05	0.05	0.05
Licorice powder	0.025	0.025	0.025	0.025
Colorant	0.25	0.25	0.25	0.25
Water	Balance	Balance	Balance	Balance
Total amount	100.00	100.00	100.00	100.00
pH	3.3	3.9	3.9	3.9
Viscosity (mPa·s)	1640	1550	1510	1320

(2) Evaluation of viscosity stability of aqueous liquid compositions

Among the aqueous liquid compositions (Examples 26-29) obtained above, the aqueous liquid composition of Example 26 was evaluated for the liquid condition by varying the temperature over the range of 10°C to 40°C. As a result, the aqueous liquid composition of Example 26 was maintained smooth despite the temperature change (10°C to 40°C).

The aqueous liquid compositions of Examples 27-29

were stored at 37°C, and their viscosities were measured over time (after three days, seven days, ten days, 14 days, 21 days, and 28 days of storage) to evaluate viscosity stability. The viscosity measurement conditions were the same as above. The results are shown in Table 5. The viscosity stability is shown in terms of the residual viscosity(%) calculated according to the equation shown in Experimental Example 1(2).

Table 5

Storage period (day)	Residual viscosity(%) after storage at 37°C		
	Ex. 27	Ex. 28	Ex. 29
0	100%	100%	100%
3	97%	93%	96%
7	97%	92%	95%
10	96%	91%	95%
14	96%	85%	99%
21	95%	Not measured	93%
28	100%	82%	90%

The results shown in the above table revealed that the viscosity of the aqueous liquid compositions of Examples 26-29 prepared using one or more of locust bean gum, tamarind seed gum, and xanthan gum did not greatly vary with prolonged storage or temperature change, and had substantially uniform properties.

(3) Sensory evaluation

The aqueous liquid compositions (Examples 26-29) obtained above were adjusted to 20°C, and two drops (about 100 mg) of one of each of the aqueous liquid compositions were then added to a single tobacco product filter tip. The time taken for the liquid to penetrate into each filter was measured in the same manner as in Experimental Example 1(3), thereby evaluating the liquid penetration ability (evaluation of liquid penetration ability). After confirming that the liquid had penetrated into filter of each tobacco product, it was evaluated by smoking each tobacco product for ease of sucking the tobacco product and whether or not the liquid had drawn into a mouth (generally referred to as "ease of smoking"). Each aqueous liquid

composition was evaluated for the liquid penetration ability and ease of smoking by the same person. The ease of smoking was evaluated by inhaling mainstream smoke three times. After smoking, the degree of color change in each filter was observed.

(4) Results

When one of each of the aqueous liquid compositions obtained in Examples 26-29 was dripped onto a single tobacco product filter tip, the aqueous liquid composition uniformly penetrated into the filter in about 15 seconds. Moreover, the aqueous liquid compositions of the invention caused no problems, such as spreading of the liquid into a mouth or causing difficulty in inhalation during smoking. Each filter after smoking was blackened, which showed that larger amounts of nicotine and tar were trapped in each filter than when the aqueous liquid composition of the invention was not infiltrated therein.

Experimental Example 4

Using the aqueous liquid composition (Example 27) prepared in Experimental Example 3, the nicotine and tar removal effects of an aqueous liquid composition of the invention were evaluated.

More specifically, the aqueous liquid composition of Example 27 was dripped onto the filter tip of a tobacco product (Mild Seven Light, Japan Tobacco Inc.: 0.7 mg nicotine content, 8 mg tar content) in an amount of about 50 mg (one drop), about 100 mg (two drops), or about 150 mg (three drops), and immediately the amounts of nicotine and tar contained in the smoke of the tobacco product were measured. As comparative experiments, the amounts of nicotine and tar contained in the smoke of comparative tobacco products were measured following the above procedure using water (one drop, two drops, or three drops) in place of the above-mentioned aqueous liquid composition. The nicotine reduction percentage(%) and the tar reduction percentage(%) were

calculated based on the amounts of nicotine and tar contained in the smoke of each tobacco product treated with one of the above-mentioned aqueous liquid compositions or water, when the amount of nicotine and the amount of tar of a tobacco product treated with neither aqueous liquid composition nor water were both defined as 100 %.

The amount of nicotine and the amount of tar contained in the tobacco product smoke were measured according to the method provided in Ministry of Finance notification No. 174 (Japan) issued in 1988 as shown below. Ten tobacco products were used for each experiment.

<Measurement of nicotine amount and tar amount>

1. Preparation of tobacco product

Tobacco products to be used for the above measurements are stored at a temperature of 22±1°C and at a humidity of 60±2% for at least two days and up to seven days before use so that the condition of the tobacco products was appropriate for the measurements.

2. Instrument and device

(1) Smoking device: Piston pump type

(2) Smoke collector: Cigarette holder provided with a glass fiber filter

The filter has a diameter of 44 mm and a thickness of 1 to 2 mm, and has a capacity of collecting at least 99.9% of all dioctyl phthalate particles with a diameter of 0.3 μm or more at a rate of 140 mm/second. The filter pressure drop at this rate is not more than 93 mm H_2O (900 Pa). The filter has an acrylate resin adhesive content of not more than 5%.

(3) Gas chromatography

(i) Measurement conditions of gas chromatography for measurement of moisture content

Column: Glass column with an inner diameter of 2-3 mm

and a length of 1.2 to 1.8 m

Filler: Porapak Q (manufactured by Waters) (80 to 100 mesh) or one whose performance is equivalent or better

Temperature: Thermostatic bath (170 to 180°C), injection part (230 to 250°C), and detector (250°C)

Carrier gas: Helium

Flow rate: 40 ml/minute

Detector: Thermal conductivity detector

(ii) Measurement conditions of gas chromatography for measurement of nicotine content

Column: Glass column with an inner diameter of 2-3 mm and a length of 1.8 to 2.7 m

Filler: Obtained by covering Chromosorb W 60-80 mesh, that has been washed with acid and distilled water with polyethylene glycol-20W (10% by weight) and potassium hydroxide (2% by weight), or one with equivalent or better performance

Temperature: Thermostatic bath (170 to 180°C), injection part (230 to 250°C), and detector (250°C)

Carrier gas: Helium or nitrogen

Flow rate: 20 to 40 ml/minute

Detector: Flame ionization detector

3. Test operation and calculation

(1) Collection of crude tar

The mouth end of a measurement tobacco product is inserted in a cigarette holder to 9±1mm. Smoking of the tobacco product is performed under the following smoking conditions until the length of the tobacco product end reaches 30 mm, and the crude tar (particles in the tobacco product smoke collected in the filter) is then collected. The number of measurement tobacco products to be smoked for collecting crude tar is 5 per smoking experiment.

<Smoking conditions>

Smoking volume (volume of tobacco product smoke

inhaled by one smoking): 35±0.3 ml

Smoking period (duration of one smoking): 2±0.1 seconds

Smoking interval (period between one smoking and the next smoking): 60±1 seconds

Smoking wave-form (puff profile): Bell type in which the maximum flow value appears 0.8 to 1.2 seconds from the starting of smoking, and the maximum flow rate is 25 to 30 ml/second.

(2) Measurement of crude tar amount

The weight of the smoke collector before and after smoking is weighed in 0.1 mg units, and the amount of crude tar (mg/tobacco product) is calculated to the second decimal based on the weight difference (figures below the third decimal place are omitted) according to the following equation.

Crude tar amount = [the weight (mg) of smoke collector after smoking - the weight (mg) of smoke collector before smoking /the number of smoked tobacco products]

(3) Preparation of a sample solution

The filter collecting the crude tar is folded up. The inner wall surface of a tobacco product holder of the tobacco product is wiped with the back side of the folded filter, and is further wiped with one quarter of an unused filter. These filters and 10 ml of extraction solvent [mixed solvent of isopropanol, ethanol, and anethole in the volume ratio of 4974 : 25 : 1, the same applies hereinafter] are put in a container, followed by shaking, giving a sample solution.

(4) Measurement of the moisture content in the crude tar

1 μl of the sample solution is placed in a gas chromatograph. The ratio of the peak area of moisture to the peak area of ethanol is then calculated. The moisture content (mg/tobacco product) in the sample solution is calculated to the

second decimal (figures below the third decimal place are omitted) using the calibration curve prepared by the method of (6)(i) described below. The daily average amount of water contained in a filter is deducted from the moisture content in the sample solution measured above, to obtain the moisture content in the crude tar. The measurement is performed twice for each sample solution, with the average of the measurement values being calculated.

(5) Measurement of the nicotine content in the crude tar

1 μl of the sample solution is placed in a gas chromatograph. The ratio of the peak area of nicotine to the peak area of anethole is then calculated. The nicotine content (mg/tobacco product) in the sample solution is truncated to the second decimal (figures below the third decimal place are omitted) using the calibration curve prepared by the method of (6)(ii) described below. The measurement is performed twice for each sample solution, with the average of the measurement values being calculated.

(6) Preparation of a calibration curve

(i) Preparation of a calibration curve for water

10 ml of extraction solvent is added to each of at least four different amounts of distilled water, the amounts of which are determined in such a manner as to cover all the estimated moisture contents in the crude tar, giving standard solutions. 1 μl of each standard solution is placed in a gas chromatograph. The ratio of the peak area of water to the peak area of ethanol is then calculated. The process is performed twice, preparing a calibration curve based on the relationship between the peak area ratio and the amount of added water.

(ii) Preparation of a calibration curve for nicotine

10 ml of extraction solvent is added to each of at least four different amounts of nicotine, the amounts of which

are determined in such a manner as to cover all the estimated nicotine contents in the crude tar, giving standard solutions. 1 µl of each standard solution is placed in a gas chromatograph. The ratio of the peak area of nicotine to the peak area of anethole is then calculated. The process is performed twice, preparing a calibration curve based on the relationship between the peak area ratio and the amount of nicotine.

(7) Measurement of the amount of tar

The amount of tar (mg/tobacco product) is determined by calculating, to the second decimal, the value obtained by deducting the amount of water and the amount of nicotine in the crude tar from the amount of the crude tar.

The results are shown in Fig. 8.

As is clear from Fig. 8, when the nicotine-reducing agent (aqueous liquid composition) of the invention is used in the filter of a tobacco product, both the amounts of nicotine and tar contained in the mainstream smoke of a tobacco product are reduced by at least 50%. As is also clear from Fig. 8, the nicotine and tar reduction effects achieved by the nicotine-reducing agent (liquid aqueous composition) of the invention are about 2 to about 5 times higher than when only water is used. Moreover, as shown in Fig. 8, the nicotine and tar reduction effects increase as the amount of the nicotine-reducing agent (aqueous liquid composition) used in the tobacco product filter increases. This shows that the amount of nicotine and tar which are contained in the mainstream smoke of a tobacco product can be controlled by adjusting the amount (the amount applied to a filter) of the nicotine-reducing agent (aqueous liquid composition) of the invention.

INDUSTRIAL APPLICABILITY

As described above, nicotine contained in the mainstream smoke of a tobacco product is effectively trapped and removed by impregnating the filter of a smoking article with the

nicotine-reducing agent of the present invention when smoking. A preferable nicotine-reducing agent in accordance with the present invention has a specific polysaccharide and an appropriate viscosity; hence, such an agent drips sharply onto the filter, and is then rapidly distributed uniformly throughout the fibers of the filter and remains in the filter. This prevents the nicotine-reducing agent from spreading into the mouth during smoking, and allows the smoker to smoke as normal with little inhaling resistance while still effectively removing nicotine.

Moreover, a preferable nicotine-reducing agent in accordance with the present invention has reduced variation in viscosity with temperature; hence it maintains an appropriate viscosity under normal conditions of use without inconveniently thickening at low temperatures during wintertime. The nicotine-reducing agent thus has the same viscosity as its indoor viscosity even during wintertime outdoors, hence being unlikely to have difficulties in dropping onto the filter.

Using the nicotine-reducing agent of the present invention, nicotine and tar contained in the mainstream smoke of a tobacco product are effectively removed, so that nicotine and tar adhere to the filter of a smoking article in larger amounts than during usual smoking. While the nicotine-reducing agent of the invention may be applied to the filter of a quit-smoking pipe or cigarette holder, it can also be directly applied to the filter of cigarette, thereby reducing nicotine in the mainstream smoke. In this case, the cigarette may be discarded after smoking, resulting in higher economic efficiency than using a quit-smoking pipe or cigarette holder.

In addition, increasing the content of the nicotine-reducing agent of the invention in a smoking article increases the amount of nicotine trapped in the filter of a smoking article. Therefore, nicotine intake can be gradually reduced by increasing the amount of the nicotine-reducing agent used, so as to gradually alleviate the nicotine dependence symptoms while cutting down on or quitting smoking.